LANSCE
Los Alamos Neutron Science Center

Research Proposal for the use of Neutron Science Facilities

☐ **Fast Access** ☐ **Joint CINT Proposal**

Proposal Number: 20111539
Submission Number: S1538
Date Received: 03/09/11

Program Advisory Subcommittee: Defense-related Nuclear Science
Focus Area:

Flight Path/Instrument: 4FP90L / FIRE House
Estimated Beam Time (days): 45
Days Recommended: 0
Dates Desired:
Impossible Dates:

TITLE
Fission Time Projection Chamber development: In-beam measurement of Pu-239 fission

☐ Continuation of Proposal #:

☐ Ph.D Thesis for:

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RESEARCH AREA

- ☐ Biological and Life Science
- ☐ Chemistry
- ☐ National Security
- ☐ Earth Sciences
- ☐ Engineering
- ☐ Environmental Sciences
- ☒ Nuc. Physics/chemistry
- ☐ Astrophysics
- ☐ Few Body Physics
- ☐ Fund. Physics
- ☐ Elec. Device Testing
- ☐ Dosimetry/Med/Bio
- ☐ Earth/Space Sciences
- ☐ Materials Properties/Test
- ☐ Other:
- ☐ Mat'l Science (incl Cond Matter)
- ☐ Medical Applications
- ☐ Nuclear Physics
- ☐ Polymers
- ☐ Physics (Excl Condensed Matter)
- ☒ Instrument Development
- ☒ Neutron Physics
- ☒ Fission
- ☒ Reactions
- ☐ Spectroscopy
- ☐ Nuc. Accel. Reactor Eng.
- ☒ Def. Science/Weapons Physics
- ☐ Radiography
- ☐ Threat Reduction/Homeland Sec.
- ☐ Other:

FUNDING AGENCY

- ☐ DOE/BES
- ☐ DOE/OBER
- ☒ DOE/NNSA
- ☒ DOE/NE
- ☐ DOE/SC
- ☐ DOE/Other
- ☐ DOD
- ☐ NSF
- ☐ Industry
- ☐ NASA
- ☐ NIH
- ☐ Foreign:
- ☐ Other US Gov't:
- ☐ Other:

PUBLICATIONS

Publications:

NONE

Abstract: S1538_TPCproposal2.pdf

By electronic submission, the Principal Investigator certifies that this information is correct to the best of their knowledge.

Safety and Feasibility Review *(to be completed by LANSCE Instrument Scientist/Responsible)*

☐ **No further safety review required** ☐ **To be reviewed by Experiment Safety Committee**

☐ **Approved by Experiment Safety Committee, Date:**

Recommended # of days:	**Change PAC Subcommittee and/or Focus Area to:**	**Change Instrument to:**

Comments for PAC to consider:

Instrument scientist signature: **Date:**

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Fission Time Projection Chamber development
- In-beam measurement of Pu-239 fission

The Pu-239 fission cross section needs to be known with very high accuracy for certain nuclear applications, and specifically to about 1% in the neutron energy range from 100 keV to 20 MeV for defense applications. Conventional methods for measuring fission cross sections are limited to 3-5%, and are thus insufficient for meeting the target accuracy. A Time Projection Chamber (TPC) for high precision fission cross sections is currently being developed in collaboration between four national laboratories and six universities to address this nuclear data need.

A prototype of the fission TPC was first tested in a neutron beam during the 2010 LANSCE run cycle, and was shown to meet all performance requirements. A picture of the detector installed on the 4FP90L flight path is shown in Fig. 1. The detector was operated both with a blank target and with a U-238 sample, and particle tracks were observed both from light charged-particles and fission fragments.

An important next step for testing the TPC is to collect Pu-239 fission data with the TPC, and we are requesting beam time on the 4FP90L flight path for this. Since Pu-239 has a fairly short half-life for alpha-decay (24,000yr), the background events caused by alpha-particles needs to be quantified.

The sample for this measurement consists of a carbon backing with a Pu-239 deposits on one side. The sample will be placed in on the central cathode plane of the TPC, and detector then placed in beam on 4PF90L. The number of neutron-induced fission events will be counted by registering the heavy-ion tracks created in the gas volume of the detector, and the time-of-flight will be used to determine the incident neutron energy. A rough cross section ratio between Pu-239 and U-235 will be calculated using data from a U-235 fission ionization chamber placed close to the TPC.

Beam time request: 6 weeks of beam time is requested to complete the measurement. The beam time requested is guided by the statistical accuracy required and the systematical studies needed to generate an accurate cross section.

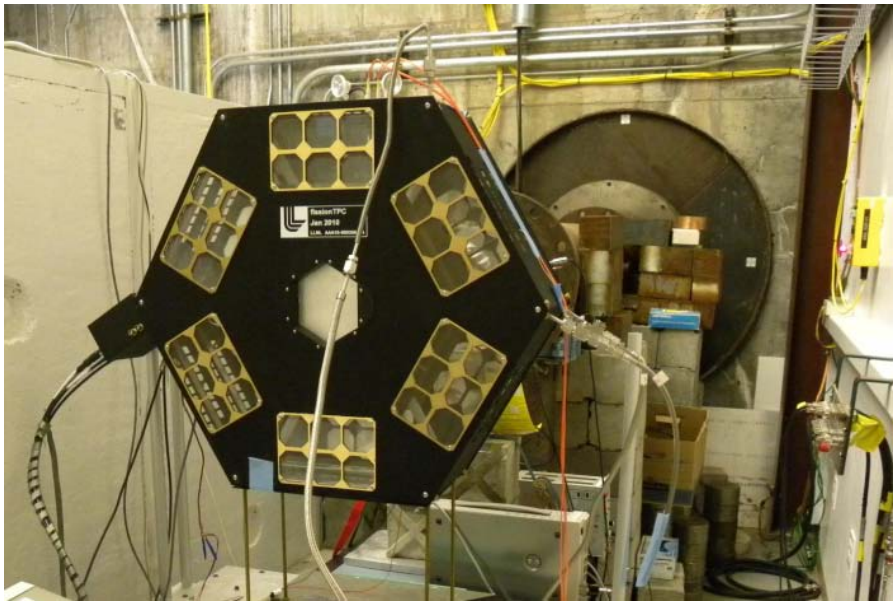

Fig. 1: The prototype fission TPC installed on 4FP90L during the 2010 LANSCE run cycle.

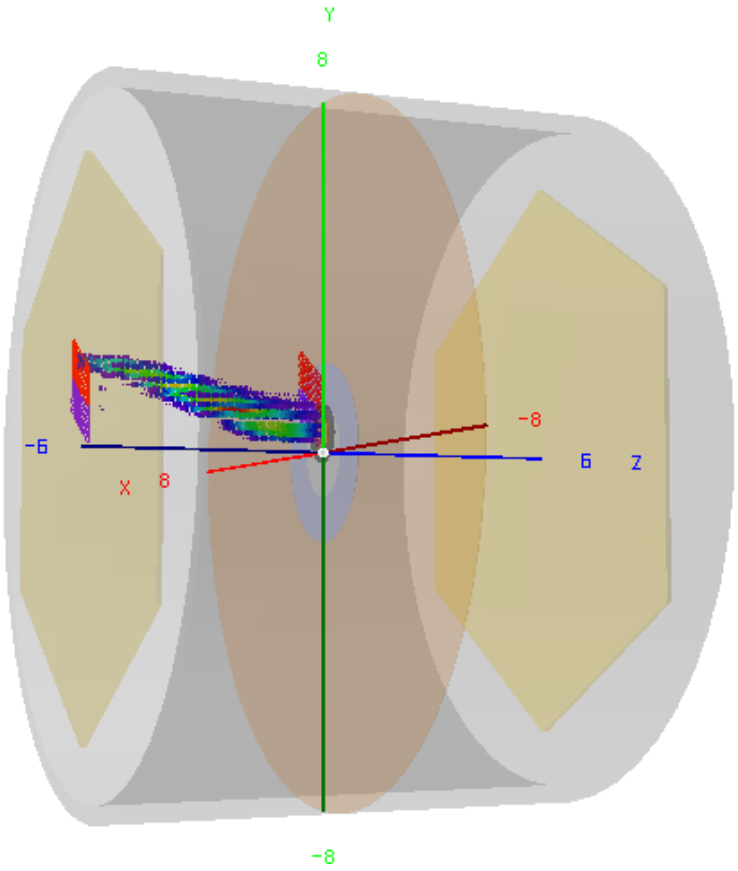

Fig. 2: Visualization of a neutron-induced fission fragment track collected with the fission TPC.